Synopsis of the Proposed

Ph.D Program in Chemistry

On

Fabrication of Newer Dye Co-Sensitized Solar Cell And Their Study

Submitted to

Swami Ramanand Teerth Marathwada University

Nanded-431606, Maharashtra State, India.

Submitted By

Mr.Maheshkumar Vijaykumar Jadhav

Research Fellow,

Department of Chemistry,

Rajarshi Shahu Mahavidyalaya (Autonomous),

Latur-413512

Under the Guidance of

Dr. K. C. Tayade

Assistant Professor

Department of Chemistry,

Rajarshi Shahu Mahavidyalaya (Autonomous),

Latur-413512

Research Center

Rajarshi Shahu Mahavidyalaya (Autonomous),

Latur-413512

Fabrication of Newer Dye Co-sensitized Solar Cell and their Study

Introduction:

Fabrication and application of newer Dye Co-sensitized Solar Cells have fascinated large interest over the last 26 years and sensitizer dye was found the crucial component in it forming the basis for light collection and charge separation. Additionally, this field is lagging behind in dynamic commercialization [1]. However, some technical problems remained to be confronted, with the utmost issue of inferior efficiencies of Dye Co-sensitized solar cells than existing silicon solar cells. Since 2013, till date the highest efficiency for Dye Co-sensitized solar cells has reported ~11.9 % as officially recognized by the National Renewable Energy Laboratory, which is very less than existing silicon solar cells (25 %) [2,3]. However, the existing silicon-based solar cells are limited to the PV market due to their towering production and environmental costs [4].

In current years, metal-free organic dyes with high molar extinction coefficients in the visible and near-infrared regions; have been studied due to their simplicity, low costs synthesis, and eco friendliness [5]. But, literature reported hitherto revealed that, Co-sensitization offers good output over the mere use of organic dyes [6].

Review of Literature and Development:

Dye-sensitized solar cells are at the frontiers of energy resources and now a day have received much attention, owing to their good photovoltaic output, even under low-light conditions. Furthermore, their fabrication procedures are relatively simple with sound flexibility in terms of colors and appearance, and their low cost.

Albeit, three decades of thorough research is done on dye-sensitized solar cells, still there are many horizons needed to be explored to further advance their performances by nearly infinite types of plausible modifications. For instance, steric groups can be encompassed in the dyes to minimize recombination reactions. Also, there is a large need for more optimal dye packing on the TiO_2 surface to enhance light absorption and to attain a better blocking effect.

After going through the literature and as far as we know there are few reports on Fluorescent Dye Co-sensitized Solar Cells, wherein Potentiostat is used to measure the performance. The Potentiostat maintains the potential of the photoelectrode at the desired

value and reads out the current at that potential, thereby giving accurate efficiency and fill factor. The various parameters including junction ideality factor in dark and under illumination, impurity concentration, Flat band potential, space charge region, spectral response, Nyquist plots, etc can be studied.

Objectives of Research:

- To induce energetically and environmentally favorable solar cell
- To synthesize newer dyes
- To synthesize Ruthenium/Cobalt metal complexes
- Characterization of synthesized motifs
- Fabrication of high efficiency solar cells by Co-sensitization

International and National Status and Significance of study:

International Status

In spite of the several researchers are highlighting the unique physical and chemical properties of solar cells only a very limited number deal with the application of these materials in commercialization due to some lacunae associated with the synthesized motifs [7]. India is dependent nation for energy and chemical sector and energy needs in India and rather the world are very large. Incessant efforts are needed to be put by researchers to avail replaceable energy resources for fossil fuels [8]. Currently, all over the world, most of the energy consumed utilizing fossil fuels which will be exhausted soon in the coming era. Solar energy is an abundant alternative energy source and India, in particular, possesses a rich solar energy source as substitute to conventional sources of energy [9].

About 96 % of solar energy is in visible region and it is needed to be converted into electrical energy which can be achieved through solar cells. Dye-sensitized solar cells have fetched substantial interest over the last few decades owing to their latent potent conversion of photovoltaic energy [10].

National status

In national scenario, there are very few people currently working on this area of research. More *et. al.* have reported syntheses of azo compounds containing thymol moiety Thymol is classified under Monoterpenoids which are naturally occurring substances and secondary metabolites of plants. Monoterpenoids are generally considered to exhibit self-defense tactics against plant enemies [11]. Recently, Waghulde *et.al.* have reported Diazo-

coupling reaction between 2-Aminothiazole and Thymol. In the work they have explored the synthesis of thymol based azo dyes, DFT based computational studies and Specific Heat Capacity calculations using thermal methods TGA-DSC [12].

Proposed Work Plan/Formulation and Structure of Study:

Time Schedule	Mile stone/ Achievable Targets
01-06 months	Review of Literature
07-12 months	Synthesis of Dyes and Complexes
13-18 months	Synthesis of Nanoparticles and Thin Films
19-24 months	Characterization of the Synthesized Motifs
25-30 months	Fabrication and Application of Solar Cells
31-36 months	Preparation and Communication of Manuscripts/Reviews, etc

Proposed Research Methodology:

A) **Synthesis** of newer dyes, complexes of various metals such as Ruthenium, Cobalt, etc, by means of various organic chemical reactions will takes place and as discussed earlier preparation of thin films. Also, we are going to fabricate the dye co-sensitized solar cells from the dyes and nanoparticles.

B) **Characterizations** such as IR, FE-SEM, XRD, TEM, etc will utilized to know the surface topography and phases of the synthesized product. UV-visible spectroscopy will be used to explore the optical properties of synthesized motifs. Also the electrochemical and photovoltaic properties will be explored.

C) **Application**: The synthesized newer dyes and thin films will be to prepare high efficiency dye co-sensitized solar cells. Applicability will be vivid only after significant lab work.

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Research Student

Mr. Maheshkumar Vijaykumar Jadhav

(M.Sc., B.Ed., SET)

Guide

Dr. K.C. Tayade

M.Sc., NET (JRF). Ph.D.

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- Name of Researcher : Mr. Maheshkumar Vijaykumar Jadhav

  (M.Sc., B.Ed., SET)
- Mobile Number : 9421455848 / 9422911875
- Email id : mjmaheshjadhav@gmail.com
- Category : Open
- Research Subject : Chemistry
- Faculty : Science
- Topic of Research : "Fabrication of Newer Dye Co-sensitized Solar Cell and Their Study".
- Research Guide : Dr. K.C. Tayade

  (M.Sc., NET (JRF)., Ph.D.)

  Assistant Professor, Department of Chemistry and Analytical Chemistry, Rajarshi Shahu Mahavidyalaya (Autonomous), Latur

  Mob.No. 9503960113 / 9923443526

  Email id:
- Mobile Number : kundantayade@gmail.com
- Research Center : Rajarshi Shahu Mahavidyalaya (Autonomous),

  Near Central Bus Stand,

  Kaku Sheth Ukka Marg,

  Latur. 413512
- Date of Registration : 16th November 2021